Ball and Socket Joint for a Motor Vehicle

Specification

The present invention pertains to a ball and socket joint for a motor vehicle, with a housing having a recess, a ball pivot which has a pin and a joint ball which is mounted with its joint ball rotatably and pivotably in the recess of the housing, whereby the pin extends through an opening provided in the housing out of this [housing], a sealing bellows arranged between the housing and the pin and with a multipart measuring array, which has at least one signal transmitter and at least one sensor.

Chassis data regarding steering angle as well as load state and spring deflection state are currently determined by means of suitable sensors in the vehicle to supply data for electronic systems. These are used for the electronic stability programs or, e.g., for headlight leveling control. These sensors are frequently coupled, as separate structural components, to the connecting rods of the chassis via mechanisms. Furthermore, an effort is made to integrate these sensors in ball and socket joints of the connecting rods, so that the joint itself is part of a sensor array.

A ball and socket joint with a ball socket connected to a housing and a ball connected to a pin that is rotatably mounted in the housing has become known from EP 0 617 260 A1. A permanent magnet, opposite which lies a magnetic sensing element arranged in the housing, is arranged in the ball end. The magnetic dipole of the permanent magnet is aligned at right angles to the longitudinal axis of the ball pivot, whereby a bellows is provided for the protection of the ball joint against the effects of the environment. By means of a rotation of the ball end in the ball socket, the permanent magnet is also rotated, such that the magnetic field in relation to the magnetic-field-sensitive sensing element changes and a position signal is generated. Additionally occurring three-dimensional movements may be considered in corresponding evaluation for control purposes.

A ball and socket joint with a housing section and a ball pin having a pin section and a ball section, which is mounted rotatably and pivotably, with its ball section, in a mount provided in the housing section, is known from DE 101 10 738 C1. In the ball section there is arranged a permanent magnet in radial alignment with the central point of the ball section, whereby a magnetic-field-sensitive sensor element is integrated into the mount. With a rotating movement of the ball section, the permanent magnet is moved in relation to the sensor element, so that the relative rotational position of the ball section in the mount can be determined.

Such ball and socket joints have the drawback that the tribological properties of the ball and socket joint may be affected negatively by the arrangement of magnet and magnetic-field-sensitive sensing element in the mounting area of the joint ball.

The object of the present invention is to provide a ball and socket joint, in which this negative effect

on the tribological properties cannot occur.

This object is accomplished according to the present invention by a ball and socket joint having the features according to claim 1. Preferred variants are described in the subclaims.

The ball and socket joint for a motor vehicle according to the present invention has a housing which is provided with a recess, a ball pivot which has a pin and a joint ball, which is mounted rotatably and pivotably, with its joint ball, in the recess of the housing, whereby the pin extends through an opening provided in the housing out of this [housing], a sealing bellows arranged between said housing and the pin and a multipart measuring array with at least one signal transmitter and at least one sensor, whereby the measuring array is arranged between the pin-side end of the joint ball and the pin-side end of the sealing bellows.

In the ball and socket joint according to the present invention, the measuring array is arranged completely outside of the mounting area for the joint ball, such that the measuring array cannot lead to any negative effect on the tribological behavior of the ball and socket joint. Moreover, the measuring array can be protected by the sealing bellows against environmental effects, such as dirt and water.

Furthermore, by providing the measuring array in the so-called "neck area" of the joint according to the present invention, compared to the state of the art, there are no restrictions on the measurement of the pivoting and/or rotation of the ball pivot against the housing. Therefore, it is possible with a ball and socket joint according to the present invention to measure the pivoting and/or rotation of the ball pivot against the housing according to all three degrees of freedom of the joint.

In the ball and socket joint according to the present invention, the signal transmitter and sensor each form a part of the measuring array, whereby preferably one part of the measuring array is arranged at the pin and another part of the measuring array is arranged at the housing for determining the pivoting and/or the rotation of the ball pivot against the housing. The edge area of the housing that surrounds the opening is especially suitable for fastening the sensor or the signal transmitter.

For the simultaneous measurement of the pivoting and rotation of the ball pivot, it has proven to be advantageous if the signal transmitter produces a dipole field. Based on the alignment and intensity of this dipole field, the pivoting and/or rotation of the ball pivot can be detected simply by means of one or more sensors. An electrical field may be selected as the dipole field; however, a magnetic field as a dipole field is preferred because of the interference immunity of magnetic fields, whereby the signal transmitter is embodied as a magnet and the sensor is embodied as a magnetic-field-sensitive sensor. All the usual magnetic sensors are suitable for the magnetic-field-sensitive sensor, whereby, e.g., a Hall sensor or a magnetoresistive sensor may be used depending on the application.

The ball and socket joint according to the present invention is not limited to a measurement of magnetic or electrical fields, however, such that audio or visual (e.g., ultrasound) measurements, which can be considered for the determination of the pivoting or rotation of the ball pivot, e.g., by the determination of reflection changes (intensity) or of interferences on aligned, flat surfaces, are also applicable. Induction methods or transit time measurements as well as combinations of the above-mentioned measurement methods can also be used.

If a magnetic signal transmitter is used, it may be embodied as a permanent magnet. However, it is also especially possible to embody the signal transmitter as an electromagnet, whereby a signal may be superimposed on the current causing the magnetic field or the current causing the magnetic field can be modulated. The modulation of the magnetic field resulting from this makes it possible to use additional effects in the measurement.

A single sensor may be sufficient for measuring the pivoting and/or rotation of the ball pivot in case of small angles of rotation. However, in the case of larger angles of rotation, providing a plurality of sensors or a plurality of signal transmitters is meaningful, whereby good results can be achieved already with two sensors. The distinction between tilting motion and rotating motion can be calculated from the individual signals of the sensors, which are preferably arranged on a circle.

The higher the number of the sensors is, the higher is the achievable resolution in the measurement, whereby it is possible to integrate a plurality of individual sensors as so-called sensor arrays in a single component. These [individual sensors] can then also supply vectorial measured variables, which are advantageous for the calculation of the alignment of the dipole field.

Preferably, the measuring array has signal transmitters and three sensors, with which larger angles of rotation of, e.g., more than 90° can be detected without problems. It proved to be advantageous if the two signal transmitters are arranged diametrically opposite one another at the pin and the sensors, forming the corner points of a triangle, are arranged at the edge area of the housing which surrounds the opening.

With the use of a plurality of signal transmitters and a plurality of sensors, it is possible to prevent the sensors from supplying unclear data in the case of superimposed rotating and tilting motions. If three sensors are used, dead centers may even be extensively ruled out in the measurement.

If two signal transmitters are embodied as magnets which are arranged diametrically opposite each other at the pin, the north pole of the first magnet is especially opposite the south pole of the second magnet and the north pole of the second magnet is opposite the south pole of the first magnet. The resulting magnetization of each magnet may, furthermore, lie on a plane that runs at right angles to the central longitudinal axis of the ball pivot. The sensors arranged preferably on the edge area of the housing that surrounds the opening are especially embodied as magnetic-field-sensitive sensors.

Instead of dipole fields, quadrupole fields or other fields of varying geometry may be used, whereby these fields may be, e.g., magnetic fields that are produced by a magnetized ring with corresponding poles, which is mounted at the pin.

The present invention is described below based on a preferred embodiment with reference to the drawing. In the drawing:

Figure 1 shows a sectional view of an embodiment of the ball and socket joint according to the present invention,

Figure 2 shows a schematic sectional view of the embodiment according to sectional line A-A' in Figure 1,

Figure 3 shows a schematic block diagram of the measuring array with evaluating unit,

Figure 4 shows a schematic block diagram of a modified embodiment with electromagnets and control electronics, and

Figure 5 shows a schematic view of a sensor array.

Figure 1 shows an embodiment of the ball and socket joint according to the present invention, in which a ball pivot 1 with a pin 2 and a joint ball 3 is rotatably and pivotably mounted in a recess 5 in a housing 6 through the intermediary of a bearing shell 4. The ball pivot 1 extends, with its pin 2, through an opening 7 provided in the housing 6 out of this [the housing 6], whereby the housing 6 is closed via a cover 8 at one end opposite the opening 7. The cover 8 meshes, together with a radial projection 9 of the bearing shell 4, with an annular groove 10 provided in the housing 6, such that the cover 8 and the bearing shell 4 are fixed at the housing 6 in a positive-locking manner.

Between the housing 6 and the pin 2 is arranged a sealing bellows 11, which, with its housing-side end, is enclosed in a groove 12 provided in the housing 6 and is held via clamping rings 13. On its pin-side end, the sealing bellows 11 has a sealing area 14, which lies at the pin 2 of the ball pivot 1 in a sealing manner.

Two recesses 15 and 16 (see Figure 2), in which magnets 17 and 18, respectively, are arranged, are provided in the pin 2. The magnets 17 and 18 are arranged diametrically opposite one another at the

pin 2, whereby the north pole N of the magnet 17 is opposite the south pole S of the magnet 18 and the north pole N of the magnet 18 is opposite the south pole S of the magnet 17 (see Figure 2). The magnets 17 and 18 are arranged at the level of the sealing area 14 at the pin 2, whereby the resulting magnetization in each of the magnets 17, 18 lies on a plane which runs at right angles to the central longitudinal axis L of the ball pivot.

Three sensors 20, 21 and 22 (see Figure 2), which can detect the magnetic field originating at the magnets 17 and 18, are arranged lying on a circle at an edge area 19 of the housing which surrounds the opening 7. An evaluation by means of an electronic evaluating unit 25 of the signals detected by the sensors supplies the pivoting α and/or rotation γ of the ball pivot 1 in relation to the housing 6 (see Figure 3).

Figure 2 shows a top view of a section along the sectional line A-A' in Figure 1, whereby, for the sake of clarity, only the cut pin 2 with the recesses 15 and 16 and the magnets 17 and 18, as well as the three magnetic-field-sensitive sensors 20, 21 and 22 are shown. The magnetic field pattern caused by the magnets 17 and 18 is indicated by means of the lines 23.

As Figure 2 shows, the magnetic-field-sensitive sensors 20, 21 and 22 are arranged lying on the corner points of a triangle, whereby the two magnets 17 and 18 lie within the area of the triangle.

Figure 3 shows a schematic view of an electrical switching circuit, whereby the three sensors 20, 21 and 22 are connected to the electronic evaluating unit 25 via electrical lines 24. The sensors 20, 21,

22 and the signal transmitters 17, 18 form the parts of a multipart measuring array M, which is shown in dotted line.

The magnets 17 and 18 are embodied as permanent magnets in the embodiment shown in Figures 1 through 3. According to a variant shown in Figure 4, the magnets 17 and 18 may also, however, be embodied as electromagnets 26 and 27, which are supplied with current by a control electronics 28 via supply lines 29. The field-generating current may be superimposed by an additional signal.

Figure 5 shows a plurality of sensors 30, 31, 32, which are combined into a single component as a so-called sensor array 33. The sensors 20, 21 and 22 shown in Figures 1 through 3 may each or all be replaced with or expanded by one or more such sensor arrays 33, whereby the sensors 30, 31 and 32 are magnetic-field-sensitive sensors.

List of Reference Numbers:

1	Ball pivot
2	Pin
3	Joint ball
4	Bearing shell
5	Recess in the housing
6	Housing
7	Opening in the housing
8	Cover
9	Radial projection of the bearing shell
10	Annular groove in the housing
11	Sealing bellows
12	Bellows groove in the housing
13	Clamping rings
14	Sealing area of the sealing bellows
15, 16	Recesses in the pin
17, 18	Magnets
19	Edge area
20, 21, 22	Magnetic-field-sensitive sensors
23	Magnetic field
24	Electrical lines
25	Electronic evaluating unit

26, 27	Electromagnets
28	Control electronics
29	Supply lines
L	Central longitudinal axis
M	Multipart measuring array
N	North poles of the magnets
S	South poles of the magnets
α	Pivoting
γ	Rotation